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Pacific Region | **Région du Pacifique**

Regional Science Advisory Process on the State of the Pacific Ocean 2010/ Fisheries and Oceanography Working Group (FOWG) Meeting

February 23-24, 2011

Institute of Ocean Sciences
Victoria, BC

Co-chairs: W.R. Crawford and J.R. Irvine

Rapporteur: A. Ross

Processus de consultation scientifique régional sur l'état de l'océan Pacifique de 2010/réunion du Groupe de travail sur les pêches et l'océanographie (GTPO)

Les 23 et 24 février 2011

Institut des sciences de la mer
Victoria, C.-B.

Co-présidents : W.R. Crawford et J.R. Irvine

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Fisheries and Oceans Canada / Pêches et Océans Canada
Institute of Ocean Sciences / Institut des sciences de la mer
9860 West Saanich Road
Sidney, BC V8L 4B2

September 2011 | **Septembre 2011**

Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenues dans le présent rapport puissent être inexactes ou propres à induire en erreur, elles sont quand même reproduites aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considérée en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

Proceedings Series 2011/032

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SUMMARY

The Pacific Region supports important resident and migratory populations of invertebrates, pelagic and groundfish, marine mammals and seabirds. Monitoring of the physical and biological oceanographic conditions and fishery resources in this Region is carried out on a semi-regular basis to understand the natural variability of these ecosystems and how they respond to natural and anthropogenic stresses. Annual State of the Pacific Ocean reports overview these conditions and are used by Fisheries and Oceans Canada to inform resource assessments and risk-based management decisions. The report on the State of the Pacific Ocean for 2010 (the 12th such annual report) was presented by members of the Department of Fisheries & Oceans Canada (DFO) Fisheries and Oceanography Working Group (FOWG) and other contributing organizations, at the Institute of Ocean Sciences in Sidney, BC on February 23 - 24, 2011. This Canadian Science Advisory Secretariat, Regional Advisory Process was chaired by Jim Irvine and Bill Crawford of Fisheries and Oceans Canada. Participants included representatives of the aforementioned government departments; Canadian and American fisheries and climate scientists from contributing academic institutions and other government departments; and representatives from commercial and non-governmental organizations. In accordance with the Terms of Reference (Appendix C), Day 2 of the meeting featured presentations from the Pacific North Coast Integrated Management region (PNCIMA) and concluded with an open-forum discussion, as summarized in these Proceedings.

This Proceedings report summarizes the relevant discussions and presents the key conclusions reached at the meeting. Additional publications, including a science advisory report and research document, from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

SOMMAIRE

La région du Pacifique soutient d'importantes populations résidentes et migratoires d'espèces d'invertébrés, pélagiques, de poissons de fond, de mammifères marins et d'oiseaux de mer. On effectue le suivi des conditions océaniques physiques et biologiques ainsi que des ressources halieutiques de cette région de façon plus ou moins régulière afin de comprendre la variabilité naturelle de ces écosystèmes et la manière dont ils réagissent aux perturbations d'origine naturelle et anthropique. Les rapports annuels sur l'état de l'océan Pacifique donnent une vue d'ensemble de ces conditions et sont utilisés par Pêches et Océans Canada pour éclairer les évaluations des ressources et les décisions en matière de gestion fondées sur le risque. Le rapport sur l'état de l'océan Pacifique de 2010 (le douzième rapport annuel de ce type) a été présenté par les membres du Groupe de travail sur les pêches et l'océanographie (GTPO) du ministère des Pêches et des Océans (MPO) ainsi que par d'autres organismes participants à l'Institut des sciences de la mer à Sidney, en Colombie-Britannique, les 23 et 24 février 2011. Ce processus de consultation scientifique régional du Secrétariat canadien de consultation scientifique a été présidé par Jim Irvine et Bill Crawford, de Pêches et Océans Canada. Parmi les participants, mentionnons des représentants des ministères susmentionnés, des scientifiques canadiens et américains dont les travaux portent sur le climat et les pêches et qui proviennent d'universités participantes et d'autres ministères ainsi que des représentants d'organisations commerciales et non gouvernementales. Conformément au cadre de référence (annexe C), au cours de la deuxième journée de la réunion, des présentations du Pacific North Coast Integrated Management Area (PNCIMA) ont eu lieu, et la réunion s'est terminée par une discussion ouverte, laquelle est résumée dans le présent compte rendu.

Le présent compte rendu résume les discussions pertinentes tenues par les participants et expose les principales conclusions formulées au cours de la réunion. D'autres documents, y compris un avis scientifique et un document de recherche, découlant de ce processus seront publiés, dès qu'ils seront disponibles, dans le calendrier des avis scientifiques du MPO à l'adresse http://www.dfo-mpo.gc.ca/csas-sccs/index-fra.htm.

INTRODUCTION

Pacific Canadian waters lie in a transition zone between coastal upwelling (California Current) and downwelling (Alaskan Coastal Current) regions, and experience strong seasonality and considerable freshwater influence. Variability is closely coupled with events and conditions throughout the tropical and North Pacific Ocean, experiencing frequent El Niño and La Niña events, particularly over recent decades. The region supports important resident and migratory populations of invertebrates, pelagic and groundfish, marine mammals and seabirds.

Monitoring of the physical and biological oceanographic conditions and fishery resources in this region is carried out by Fisheries and Oceans in partnership with other government departments, academic institutions and organizations to understand the natural variability of these ecosystems and how they respond to both natural and anthropogenic stresses. The Fisheries and Oceanography Working Group (FOWG), in conjunction with the regional Centre for Science Advice Pacific (CSAP) and the Canadian Science Advisory Secretariat (CSAS) in Ottawa, provides annual reporting on the state of the Pacific Ocean. Presentation of the annual State of the Pacific Ocean report to the FOWG provides an opportunity for group members and other attendees to review and discuss the data from these monitoring programs and to provide input to the Science Advisory Report (SAR) prepared by the co-Chairs.

The Terms of Reference were reviewed by the Chair (Bill Crawford) at the beginning of Day 1. The goal of the meeting was to develop a synopsis of the physical and biological state of the ocean off Canada's Pacific coast in a workshop setting. Relevant scientific information was provided in short (~15 minute) presentations, followed by discussion. This year's FOWG meeting also included presentations and discussion focussed on the Pacific North Coast Integrated Management Area (PNCIMA), to be used in the development of a separate Report. Members of the PNCIMA Integrated Oceans Advisory Committee (IOAC) were welcomed, and the goals of the PNCIMA session reviewed by the Chair (Jim Irvine) at the start of Day 2.

The following summarizes the information presented and reviewed during the 2011 FOWG Meeting, from which the accompanying Research Document and Science Advisory Report were prepared.

REVIEW

The year 2010 started with extreme El Niño weather along the west coast, with strong southerly winds bringing warm, fresh ocean waters to the Oregon and British Columbia coast. These winds weakened in April and by summer the winds blew much more strongly than normal from the north, upwelling cool salty water along the outer coast. Waters of the Strait of Georgia shifted from cool to normal or even warm in 2010. La Niña conditions of late 2010 and early 2011 were linked to stronger westerly winds in the Pacific Ocean and cooler ocean waters along the coast. Overall the cool conditions prevailed in 2010, and this year was the third consecutive year with cooler than normal ocean temperatures along the Pacific Canadian coast.

Over the past decade and a half both the Pacific Decadal Oscillation and ENSO (El Niño – La Niña) have shifted phase together and reinforced the impact of each one on west coast ocean temperature. Whereas in the 1990s scientists would attribute changes in ocean temperatures and species compositions to changes in PDO or ENSO, they have recently been able to use these indices almost interchangeably in local waters to link physical changes in the ocean to shifts in abundance of one or several marine species.

Scientists monitor abundance and species of plankton in local waters to determine the quantity and quality of prey for larger species. Phytoplankton can be tracked by measuring chlorophyll in the ocean. Summer 2010 chlorophyll concentrations were often low in the southern Strait of Georgia and Juan de Fuca Strait, while fall chlorophyll concentrations were higher in Juan de Fuca Strait and slightly lower in the Strait of Georgia compared with previous years. The timing of the spring bloom in the Strait of Georgia is considered important for juvenile herring and salmon survival. Numerical models suggest that this bloom occurred in mid-April in 2010, compared to March to early April for most years. Bloom timing depends on local winds and cloud cover. A study of Rivers Inlet of Central BC discovered the spring bloom could be blown completely out of this short inlet by outflow winds. Its late development in 2009 could have been due to these winds. Studies of impacts of this outflow on local sockeye juveniles are ongoing.

Zooplankton species off the west coast tend to shift from cold-water to warm-water types with corresponding shifts in local ocean temperature. Monthly surveys found the 2010 composition of cold-water copepods (a type of zooplankton) off Oregon was 4th highest in 15 years of observations. However, the species richness, which usually correlates with ocean temperature, was also high in 2010. These contrasting observations might be attributed to a warm ocean waters in winter and cool summer of 2010. Similar surveys in British Columbia observed more cold-water copepods species.

Recent surveys found the that biomass of *Pandalus jordani* shrimp off central west coast Vancouver Island had increased in 2008, 2009, and 2010 from very low levels during 2004-2007. Such increases appear related to colder waters in 2006, 2007, and 2008 during the larval stages of the shrimp (this species has a 2-yr time lag from hatch to recruitment at age 2) and to low abundances of Pacific hake (a potential shrimp predator) in May surveys in 2008, 2009, and 2010. This survey in May also provides insight into populations of resident flatfish, such as sole, Pacific cod, halibut, and arrowtooth flounder. Biomass trends of key flatfish indicator species all increased in 2010, as did the biomass of the "cold water indicator" species walleye pollock.

Pacific hake migrate into BC waters mostly in summer. Their biomass has been somewhat low over the past few years, but a strong 2008 year-class might raise numbers soon. Accurate acoustic estimates were not possible in 2009 because of large numbers of Humboldt squid. Herring adult biomass is generally low, although the Strait of Georgia stock remains somewhat high due to its near-record high biomass several years ago and indications of strong returns in 2011. Sardine numbers went from zero to many thousands of tonnes in the 1990s, but have declined since 2006. Eulachon have experienced long-term declines in many rivers throughout their distribution from California to Alaska. Indices of eulachon abundance in central and southern British Columbia rivers remain at low levels. COSEWIC recently assessed eulachon in some BC rivers as "threatened" and in some others as "endangered". The abundance of albacore tuna in BC coastal waters in 2010 was the second highest since 1990, and those caught were in cooler water than in previous years.

Sockeye Salmon returned to the Fraser River in record high numbers during 2010. Approximately 30 million adults returned, of which about 17 million were bound for Shuswap Lake. These returns contrast with 2009 when fewer than 2 million sockeye migrated back to the Fraser. With such wide changes between years it is difficult to predict future returns. The DFO prediction for 2011 is between 1.0 and 12 million (10% and 90% probabilities) if the low recent productivity persists. If, on the other hand, salmon have the long-term average productivity seen last year and in previous decades, between 1.7 and 15 million sockeye are predicted to return.

The story was reversed for Humboldt squid. These were found in record-high numbers along the west coast during the summer of 2009, but none were observed in British Columbia waters during 2010. Several causes have been proposed, but none proven.

Counts of seabirds in Pacific Rim Marine Reserve of the west coast of Vancouver Island revealed many species increased in number over the past five years. However, on Triangle Island where seabird breeding depends critically on ocean conditions in April, the mean growth rate for chicks of Cassin's auklet was extremely low in 2010 – in fact, the lowest in the 15-year time series by quite a wide margin. This poor growth is linked to late arrival of spring weather.

A groundfish overview focusing on PNCIMA revealed several general trends. Gadoid (Pacific Cod, Walleye Pollock, Pacific Hake) stocks are stable or increasing. Most rockfish species are at low abundance with many being listed as Special Concern or Threatened by COSEWIC. Flatfish stocks appear to be stable. Sablefish stocks appear to be stable at low abundance. Lingcod and Elasmobranch (e.g. Spiny Dogfish) stocks also appear stable.

Sockeye Salmon ocean survival was high for stocks in Barkley Sound on the west coast of Vancouver Island, attributed to cool ocean waters when they entered the ocean two years earlier. An assessment of 50-year trends in returns of five salmon species to the central and north coast suggests that Pink Salmon are doing relatively well in this area, whereas Coho Salmon and Chinook Salmon are doing relatively poorly. A different picture can emerge from shorter-term studies. For example, the Chinook Abundance Index has increased for the past three years in British Columbia and neighboring US states.

The numbers of some baleen whales have increased following the end of whaling in the 1960s. Humpback whales are now most frequently sighted. Fin, blue and sei whales are observed much less frequently.

Oxygen concentrations in bottom waters at 150 metres depth in late summer dropped to lowest observed values in 2006 and 2009 off Southwest Vancouver Island, likely following a trend observed off Oregon and Washington. Normal concentrations were observed in 2010. However oxygen concentrations at depths less than 100 metres are much lower off Oregon.
Finally, biophysical features and human uses on the BC coast are illustrated by 260 new maps prepared by the BC Marine Conservation Analysis Project Team.

DISCUSSION

Attendees were invited to comment on each presentation during the 2-day meeting and to participate in open-forum discussions at the conclusion of each day. Talks were grouped under three main headings: Global, Deep-Sea and West-Coast Vancouver Island; mostly Salish Sea; and mostly PNCIMA and neighbouring waters (Appendix A). Questions and comments pertaining to the oceanography and biology talks in each group are summarized below, along with the discussions held at the end of each day.

GLOBAL, DEEP-SEA AND WEST COAST VANCOUVER ISLAND

Oceanography

Increased stratification and a gradual shoaling of the mixed layer and dissolved oxygen minimum layer were among the general observations that emerged during these talks. A question as to the quality of the base-period data used in determining oxygen anomalies was

addressed with the comment that such data are quite impressive and comprehensive. Regarding the spatial variability in upwelling trends associated with using spatially-averaged wind-stress data, these were claimed to be fairly coherent along the west coast.

Biology

Ocean upwelling, sea-surface temperatures, and the timing of spring plankton blooms (which, in the Strait of Georgia, might be seeded by those in mainland inlets) were found to be major determinants of productivity. Early blooms and colder waters in the central coast favour many fish populations and their predators, including fish-eating birds. A question as to whether albacore tuna (which were found in colder waters than normal in 2010) are tracking temperature fronts was met with the response that albacore are visual feeders and may, therefore, be attracted to the deeper colours associated with these fronts. A question regarding by-catch of eulachon (which are currently in decline) was addressed with the comment that by-catch interruption devices (BIDs) are available to shrimp fisheries and that fishing should be stopped if by-catch exceeds 1% of the shrimp catch.

MOSTLY SALISH SEA

Oceanography

Talks in this session included presentations from the ocean observatories NEPTUNE and VENUS. The latter recorded cold, fresh, and low spring/summer dissolved oxygen conditions in Saanich Inlet during 2010, which correlate well with observations described in other talks.

Biology

Water temperature was a major determinant of plankton diversity and productivity, an increase in the abundance of warm-water zooplankton (as well as jellyfish and salps) off the coast of Vancouver Island contrasting with the predominance of cold water plankton in the Strait of Georgia, which lacked the cool-warm cycle observed off the west coast during 2010. The latter correlates with the good survival observed for Chinook salmon in 2010, and the high returns predicted for the Columbia River population in 2012. In contrast, numbers of hake and certain other groundfish appear to have declined with decreasing water temperature since 2008, although discriminating between hake and (Humboldt) squid is difficult using current acoustic methods.

DAY 1 Discussion

The discussion at the end of Day 1 focussed on the relationship between water temperature and productivity, and the observation that colder waters appear to correlate with an increase in plankton abundance and juvenile salmon survival. It was suggested that this may explain the apparent turnaround of several fish populations in 2010, which was a relatively cold year, although conditions during their earlier stages of development are also important for salmon.

MOSTLY PNCIMA AND NEIGHBOURING WATERS

Oceanography

The long-term trends presented in these talks include a general warming and freshening of sea water along the B.C. coast, as determined from lighthouse records, and a decrease in dissolved

oxygen off southwest Vancouver Island, as measured by titration of water collected at 125m. A question was posed regarding the accuracy and consistency of the lighthouse temperature records. The response was that some measurements may drift, since it is not possible to check/recalibrate the instrumentation that regularly, but that new thermometers were being installed at some locations, and that a 2-month overlap of the readings made using old and new thermometers would be used to check the accuracy of the former. It was also pointed out that salinity measurements made at Egg Island, which appeared to be anomalous at first, are in fact consistent with other observations, such as the timing of freshwater inputs. These also featured in presentations on Rivers Inlet, in which the highest plankton biomass occurs before the freshet decreases the salinity of surface waters in summer, resulting in advective loss of nutrients that may be exacerbated by strong offshore winds. It was also pointed out that sediment traps have collected plumes of material apparently exported from northern inlets, but at frequencies that appear to be tidally related. The discovery that BC glaciers are losing the equivalent of about 22 cubic kilometres of water each year prompted a question as to how much glacial melt contributes to river flow. The answer (up to 10%) suggests that the loss of glacial ice could eventually have a major impact on the fish that spawn in certain rivers.

Biology

Variability in certain fish populations can largely be explained by the population dynamics of prey species, although fish age may also be a factor (particularly with regard to survival). For example, recruitment (production of new spawners) for herring and, to a certain extent, Sockeye Salmon can be modeled based on the biomass of euphausids (an important prey type) in the appropriate years. Because euphausid biomass in Barkley Sound was low in 2010, recruitment, growth and survival may remain low for west coast Vancouver Island herring, and also for juveniles of local sockeye populations. It was also noted that herring of a specific age were significantly smaller in 2010 than in previous years, although this may be a cyclic trend. In response to a question about the effect of commercial fishing, it was noted that this is taken into account when modeling fish populations based on prey biomass. Regarding salmon trends in PNCIMA, the comment was made that catch data can include significant contributions from migrating fish (at least for certain species) and should, therefore, be omitted. The response was that straits and other large areas will always contain mixed stocks, but that there is now a move towards management at the Conservation Unit (CU) level (biological groupings of salmon rather than management groupings) and that this approach may be used in the future. Salmon catches from areas likely to be dominated by migrating fish were ignored in the analysis.

Regarding sockeye salmon in particular, returns for northern populations were generally a little lower than predicted but significantly higher than expected for central and west coast Vancouver Island populations in 2010. These observations correlate well with lagged El Niño and La Niña events; for example, the low northward transport and cooler sea-surface temperatures associated with La Niña in 2006-2009 led to increased production and, subsequently, the higher returns observed in 2010. In contrast, the 2010 El Niño will likely lead to poor marine survivals of smolts as 4-year-old adults in 2012. PNCIMA still accounts for about two-thirds of BC groundfish catches, although stocks of some species are not yet stable enough to exploit.

DAY 2 Discussion

Discussions at the end of Day 2 helped to focus some of the ideas presented during the meeting. The apparent anomaly (especially for a warming planet) of a cool water mass surrounded by warm water in the sub-Arctic North Pacific was attributed to the cool equatorial Pacific waters associated with La Niña. It was also suggested that concerns over the selection

of baseline data from a particular period (e.g. the 'base periods' used for determining sea-surface temperature anomalies) might be addressed by the use of a 'running mean'.

In response to a comment that the northward shift in hake populations appears contradictory with respect to the cooler regime in 2010, it was suggested that this shift might be related to hypoxia (although hake are quite well adapted to low oxygen levels). Bigger fish also tend to migrate further north, as has been observed with hake in the past; however, that does not appear to be the reason in this case.

Another comment spoke to the disparity of scales on which data are currently being collected, and the extrapolation of high-frequency data to provide future estimates. It was suggested that attempts should be made to use all the available oceanographic and biological data in order to begin establishing mechanistic links, and that recent advanced in modelling may help in this regard. A similar point was made in connection with the Cohen Commission, which has shown that DFO has the capacity to do great science but that greater synthesis is needed. It was suggested that an inventory of who is working in which area, and on what scale, would help to address this issue, and that the Fisheries and Oceanography Working Group is a good step in that direction.

Another suggestion was to adopt a 'report-card' monitoring process of the kind discussed during at the recent Strait of Georgia meeting, which focused largely on the development of suitable indicators for this purpose. This approach was also discussed at a recent PNCIMA meeting, although large ocean management areas like PNCIMA would likely require more of a systems view. It was further suggested that those agencies first set up to establish and manage Marine Protected Areas should be consulted since they have established expertise in this field, and strategies for managing larger conservation areas should mesh with those for smaller areas.

There is currently a major international focus on addressing the issues surrounding the selection of objectives and indicators for integrated ecosystem management. However, the development of a report-carding process by DFO would have to be targeted, and the objectives discussed by scientists and managers before proceeding with the selection of indicators.

RECOMMENDATIONS

1. A Science Advisory Report will be drafted by J. Irvine and B. Crawford presenting the key/important highlights from the presentations for review by the meeting participants.

2. J. Irvine and B. Crawford will compile summaries of the presentations provided by individual presenters in the Appendix of a Research Document and write an introduction that synthesises the key findings.

3. DFO scientists and managers should continue working together to identify objectives and indicators in support of integrated ecosystem management.

4. Better communication is needed within DFO to promote mutual awareness and co-ordination of different groups working in related areas.

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REFERENCES

Crawford W. R. and J. R. Irvine. 2011. State of physical, biological, and selected fishery resources of Pacific Canadian marine ecosystems in 2010. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/054. x + 163 p.

DFO. 2011. State of the Pacific Ocean 2010. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/032.

APPENDIX A: AGENDA

State of the Ocean Meeting Agenda
Stewart Auditorium, Institute of Ocean Sciences,
9860 West Saanich Road, Sidney, BC,
23-24 Feb 2011

Wednesday 23 Feb 2011 (0930 h – 1700 h)

Global, Deep-Sea, West Coast Vancouver Island

Bill Crawford	Global and Gulf of Alaska weather and climate
Marie Robert	Changes in water properties along Line P (presented by B. Crawford)
Howard Freeland	Update of the Argo view of the Gulf of Alaska
Frank Whitney	Oxygen and nutrients in the subarctic Pacific
Angelica Peña	Strait of Georgia phytoplankton
Jim Gower	Updates of ocean observations by satellites and weather buoys
Sonia Batten	Zooplankton in Gulf of Alaska
John Holmes	Albacore tuna in coastal waters during 2010
Bill Peterson	Ocean conditions and salmon forecasting off Oregon and Washington
Yuri Zharikov	Trends in Marine Life in Pacific Rim National Cons. Area
Ian Perry	Small-mesh multi-species bottom-trawl survey results
Mairi Best	NEPTUNE Canada: Early results from real-time, high-resolution data
Chuck Parken	Chinook salmon abundance trends in fisheries managed under the PST
Dave Mackas	Zooplankton in west coast Canadian waters
David Welch	Acoustic Array-Based Measurements of Coastal Ocean Survival of Juvenile Salmon, 2006-2010.

Mostly Salish Sea

Jan Newton	Oceanography of US portion of Salish Sea
Verena Tunnicliffe	VENUS continuous observations (R Dewey)
Angelica Peña	Strait of Georgia phytoplankton
Robie Macddonald	Salish Sea pH (with S. Johannessen and D. Ianson)
Susan Allen	Update on the timing of the spring bloom in the Straight of Georgia
Greg Workman	Review of groundfish surveys & oceanographic data from 2010 Review of 2010 Hake survey
Lyse Godbout	Linkages between salmon survival, their timing of sea entry & marine productivity
Sue Grant	Fraser River Sockeye Salmon
Peter Olesiuk	State of Pinnipeds in BC
All	Discussion

Thursday 24 Feb 2011 (0830h – 1600 h)

Mostly PNCIMA and neighboring waters

Peter Chandler	Long term trends in lighthouse temperature records
John Morrison	Freshwater discharge along the southern BC coast & PNCIMA
Bill Crawford	Oxygen in bottom waters of the shelf (R. Tanasichuk, R. Pawlowicz)
Karin Bodtker	BCMCA (British Columbia Marine Conservation Analysis): Compiling & analyzing coastwide spatial data for marine planning
Doug Biffard	Shoreline Sensitivity & Climate Change Adaptation in the Coastal & MPAs of BC
Ron Tanasichuk	Euphausiids and WCVI Fish Production, PNCIMA herring and sockeye
Gary Borstad	Chlorophyll observed from satellites (L. Brown)
Patrick O'Hara	Information on seabirds from Raincoast Cons. Foundation study (K. Morgan)
Mark Hipfner	Seabirds on Triangle Island
Brian Hunt	Overview of Rivers Inlet Ecosystem Study

Rich Pawlowicz	Seasonal and Interannual a) physical dynamics in Rivers Inlet and b) hydroacoustics in Barkley Sound
Jake Schweigert	Small Pelagics (Salish Sea, WCVI, & PNCIMA) (Jennifer Boldt)
Susan Allen	Impact of wind & river flow on the timing of the Rivers Inlet Spring Phytoplankon Bloom
Jim Irvine	Salmon Catch & Escapement Trends in PNCIMA
Kim Hyatt	Update of Indicator Sockeye salmon populations
Marc Trudel	Results of ship-based net surveys of surface waters (Marc at sea; will send slides)
Linda Nichol	Recent surveys of large cetaceans (Linda Nichol, John Ford, Robin Abernethy)
Chris Grandin	Pacific Hake (J. Holmes)
Greg Workman	Status of groundfish resources in PNCIMAGroundfish (speaker to be confirmed)
Ray Lauzier	Shellfish (Graham Gillespie)
Tom Therriault	Invasive Species (Graham Gillespie)
All	Discussion

APPENDIX B: ATTENDEES

√ W = Webinar Attendee

Last Name	First Name	Affiliation	Attend Feb 23	Attend Feb 24
DFO Participants				
Boldt	Jennifer	DFO Sci PBS	√	√
Abernethy	Robin	DFO Sci PBS	√ W	√
Brown	Laura	DFO Sci PBS		√ W
Brown	Robin	DFO Sci IOS	√ W	√
Chandler	Peter	DFO Sci IOS	√	√
Cherniawsky	Josef	DFO Sci IOS	√	√
Crawford	Bill	DFO Sci IOS	√	√
Davis	Neil	DFO PNCIMA Coord		√
Folkes	Michael	DFO Sci PBS	√ W	√
Freeland	Howard	DFO Sci IOS		√
Galbraith	Moira	DFO Sci IOS	√	
Gatien	Germaine	DFO Sci IOS	√	√
Godbout	Lyse	DFO Sci PBS	√	√
Gower	Jim	DFO Sci IOS	√	√
Holmes	John	DFO Sci PBS	√ W	
Holt	Carrie	DFO Sci PBS	√	√
Hourston	Roy	DFO Sci IOS	√	√
Hyatt	Kim	DFO Sci PBS		√ W
Irvine	James	DFO Sci PBS	√	√
Keightley	Stephanie	DFO Sci PBS	√	√
Kotyk	Mel	DFO NC		√ W
Lake	Diane	DFO Comm	√ W	√ W
Lemieux	Jeffrey	DFO NC	√	√
Mackas	Dave	DFO Sci IOS	√	
Morrison	John	DFO Sci IOS	√	√
Nemcek	Nina	DFO Sci IOS		√ W
Neville	Chrys	DFO Sci PBS	√ W	√ W
Nichol	Linda	DFO Sci PBS		√ W
O	Miriam	DFO Sci IOS		√
O'Brien	Michael	DFO Sci PBS	√	√
Olesiuk	Peter	DFO Sci PBS	√ W	√ W
Parken	Chuck	DFO Sci PBS	√ W	
Peña	Angelica	DFO Sci IOS	√	√
Perry	Ian	DFO Sci PBS	√	√
Richardson	Wendy	DFO Sci IOS		√
Robert	Marie	DFO Sci IOS	√	
Romaine	Stephen	DFO Sci IOS	√	√
Ross	Andrew	DFO Sci IOS	√	√
Saunders	Mark	DFO Sci PBS	√	√

Schweigert	Jake	DFO Sci PBS		√ W
Stockwell	Margot	DFO Sci PBS	√ W	
Tanasichuk	Ronald	DFO Sci PBS		√
Young	Kelly	DFO Sci IOS		√ W
Whitney	Frank	DFO Sci IOS Rt	√	√
Workman	Greg	DFO Sci PBS	√	√
Zhang	Zane	DFO Sci PBS	√	√ W
EXTERNAL PARTICIPANTS				
Abeysiriguhawardena	Dilumie	NEPTUNE Canada	√ W	
Akenhead	Scott	Ladysmith Institute	√	√
Alidina	Hussein	World Wildlife Fed		√ W
Allen	Susan	UBC	√	√
Argue	Sandy	Province of BC		√ W
Bertram	Doug	EC at IOS	√	√
Best	Mairi	NEPTUNE Canada	√	√
Biffard	Doug	Province of BC	√ W	√
Blackbourn	Dave	DFO Retired	√	√
Bodtker	Karin	Living Oceans Society	√	√
Bolingbroke	Nick	DFO Contractor	√	√
Borstad	Gary	ASL Borstad Sidney	√	√
Brown	Leslie	ASL Borstad Sidney	√	√
Cameron	Ross	BC Ferries & PNCIMA IOAC		√
Campbell	Colin	BC Sierra Club	√ W	√
Carswell	Barron	Province of BC	√ W	√ W
Chalmers	Dennis	Province of BC	√	√
Dewey	Richard	UVIC/Neptune	√ W	√ W
Driscoll	John	Living Oceans Society	√	√
Dudas	Sarah	VIU Nanaimo	√ W	
Etzkorn	Jacob	Living Oceans Society		√
Hay	Doug	DFO Retired	√	√
Heesemann	Martin		√ W	
Hoeberechts	Maia	UVIC/Neptune		√
Holmes	Heather	Parks Canada	√	√
Honka	Leah	Cdn Parks & Wilderness Soc.	√	√
Hunt	Brian	UBC	√	√
Jessen	Sabina	Cdn Parks & Wilderness Soc.		√
Jones	Greg	Environment Canada	√	√
Krembs	Christopher	Wash State Dept of Ecology	√ W	
Li	Lingbo	UBC	√	
Matabos		NEPTUNE Canada		√
McIsaac	Jim	PNCIMA IOAC	√	√
McKinnell	Skip	PICES		√
Mihaly	Steve	NEPTUNE Canada	√	√
Minato	David	BC Salmon Farm. Assoc.		√
Moore-Maley	Ben	UBC	√	√

Okey	Tom	West Coast Aquatic	√	√
Opala	Richard	Marine Harvest	√	
Owens	Dwight		√ W	
Pawlowicz	Richard	UBC	√	√
Petrova	Eugeniya	UBC	√	√
Welch	David	Kintama	√	
Wong	Cecilia	Environment Canada	√	√ W
Wright	Kim	Living Oceans Society	√	√
Zharikov	Yuri	Parks Canada, Pacific Rim	√	√

APPENDIX C: TERMS OF REFERENCE

Terms of Reference

State of the Pacific Ocean: 2011 Workshop

Pacific Regional Science Advisory Process

February 23-24, 2011
Sidney, B.C.

Chairpersons: Bill Crawford and Jim Irvine

Context

Annual state of the ocean reporting in the Pacific Region is provided by the DFO Pacfific Fisheries and Oceanography Working Group (FOWG), in conjunction with the regional Centre for Science Advice Pacific (CSAP) and the Canadian Science Advisory Secretariat (CSAS) in Ottawa.

Significant changes have occurred in recent years in physical and biological oceanographic conditions and the state of fishery resources. Annual monitoring and reporting provides a synopsis of current status, how it is changing, and how these changes may affect commercial and non-commercial resources in the region.

The influences of ocean conditions are an important component of fishery resource assessment. The annual State of the Pacific Ocean Report provides an overview of these conditions. which can then be used by DFO Science Branch in resource assessments. DFO Fisheries and Aquaculture Management Branch, and Oceans, Habitat and Enhancement Branch, incorporate information provided in the annual State of the Pacific Ocean Report to inform risk-based management decisions. In addition, the report responds to a growing public interest in the state of the North Pacific Ocean.

Objectives

1. To develop a synopsis of the physical and biological state of the ocean off Canada's Pacific coast in a workshop setting. Focusing on 2010, relevant scientific information will be provided in short (~15 minute) presentations followed by discussion.
2. To conduct focused presentations and disussion on the Pacific North Coast Integrated Management Area (PNCIMA), that will subsequently be used in the development of a separate DFO Manuscript Report.

Expected publications

CSAS Research Document
CSAS Science Advisory Report
CSAS Proceedings
DFO Manuscript Report (to be completed by November 2011, focused on PNCIMA, as part of a national State of the Oceans initiative)

Participation

Participants (approximately 70) will include DFO Oceans and Resource Assessment sectors primarily within Science, and external participants from academia, other Canadian and American federal and provincial agencies, and the NGO community.

References Cited

Published reports from previous years are available at: http://www.pac.dfo-mpo.gc.ca/science/psarc-ceesp/osrs/index-eng.htm